

# ECONOMICS OF DAILY-DEAL WEBSITE: ADVERTISING AND SAMPLING EFFECTS

*Completed Research Paper*

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## Abstract

*With the advent of Groupon.com in 2008, daily deal platforms have seen phenomenal growth. Surprisingly there is very sparse analytical research that has studied the economics of the daily deal platforms that they connect merchants to consumers. We develop a stylized two-period Stackelberg leader-follower game-theoretic model to analyze the strategic interaction between heterogeneous merchants and a daily-deal website. The monopolist daily deal website is revenue maximize. Merchants take into consideration the sampling, advertising and cannibalization effects when they decide participation and discount strategy on the daily-deal website. Our result shows the merchants offer higher discount rates on the daily deal website and less known merchants benefit more from offering deals on the daily deal website. Some of the merchants never offer a deal on the platform even if offering a deal on the platform is free.*

**Keywords:** Daily-deal website, experience good, sampling, advertising

## Introduction

Daily-deal business models came to limelight with the advent of Groupon in 2008 which became the fastest online business to reach one billion dollar valuation in history (Steiner, 2010). Though it is only the fifth year (Dholakia, 2012) of evolution for online daily-deal industry, it is estimated that consumers will spend \$ 3.6 billion on the daily-deal websites in 2012. It is an increase of nearly 87% over 2011 spends and around 60% of all online shoppers subscribe to a daily-deal website in the US (Freed & Berg, 2012). While daily-deal industry has seen phenomenal growth in the last five years, market analysts have raised concern about its sustainability, growth and profitability (Clifford & Miller, 2012) and business models pursued by these websites have been questioned (Cohan, 2012; Etter & McMillan, 2012).

A daily-deal website offers consumers with “deals” per day in each of the local markets it serves. Consumers and merchants are drawn to the daily-deal website for attractive deals and large market coverage respectively. Though the daily-deal websites are similar to coupons in that the daily-deals also provide discounts, there are some key differences. First, daily-deal websites like *Groupon.com* or *LivingSocial.com* offer deals and often offer discounts of more than 50% while traditional coupons are more heterogeneous with relatively lower discount rates and many times coupons have a dollar value. Second, the daily-deals offered by these websites have to be first purchased by the consumers and then used to get the service or product from the merchant and these deals are often non-refundable. On the other hand, a coupon or a voucher, digital or printed, is redeemed only at the point of purchase. The third key difference is that these digital deals are offered on the website and the daily-deal website can monitor sales of deals. The ability of the websites to monitor revenue generated by sales allows them to offer a revenue sharing contract which may not be viable in the case of traditional coupons. This revenue sharing agreement between merchants and the website is viewed as more effective in attracting businesses as they pay only when consumers take action of buying the deal. Though merchants share transaction revenue with the website, they do not pay large upfront fixed fee of traditional marketing channels like advertising which do not guarantee commensurate additional revenue generation.

This unique business model of daily-deal websites was hailed as the ultimate electronic commerce business model. At the peak, there are over 10,000 daily-deal websites worldwide, majority in Asia, in June 2011. Interestingly enough, market changed dramatically since after highly successful public offering of Groupon in November, 2011. Groupon has lost more than three fourths in market valuation, LivingSocial, arguably the second largest daily-deal website, postponed its anticipated IPO and thousands of daily-deal websites have closed.

The rise and fall of daily-deal websites in such a short time horizon has drawn attention from analysts from Wall Street to entrepreneurs at San Jose. Heated debates focus on the business model, especially on the “lopsided” agreements with merchants.<sup>1</sup> Many critics view it is as too costly for merchants to offer 50% discount and then share 50% transaction revenue with the daily-deal website.<sup>2</sup> Moreover, one does not observe much variation in discount rates of deals and revenue sharing agreements. This narrow range of revenue sharing ratio may render daily-deal websites attractive to only certain types of merchants.<sup>3</sup>

Thus, it is important to understand the dynamics of a daily-deal website’s revenue sharing contract with merchants. In order to study the impact of revenue sharing ratio on merchants’ participation and discount rate strategy, in this paper, we develop an analytical model to explore the following questions: (i) When, and more specifically, for what type of businesses offering deals on a daily-deal website may be profitable? (ii) How the interplay of advertising, sampling and cannibalization effects impact merchant’s participation and discount strategy on daily-deal website? (iii) How business and consumer characteristics affect the profitability of merchants and in turn affect the websites optimal revenue sharing ratio?

Consumers in the local market are often not aware about the product and service offerings of some merchants. Local merchants participate in daily-deal website to reach out to large number of consumers

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<sup>1</sup>[http://www.slate.com/articles/technology/technology/2012/08/groupon\\_earnings\\_report\\_the\\_daily\\_deals\\_site\\_s`\\_crummy\\_business\\_model\\_is\\_finally\\_dead\\_hooray\\_.html](http://www.slate.com/articles/technology/technology/2012/08/groupon_earnings_report_the_daily_deals_site_s`_crummy_business_model_is_finally_dead_hooray_.html)

<sup>2</sup>Groupon-Hysteria, <http://www.forbes.com/sites/chunkamui/2011/06/03/groupon-hysteria/>

<sup>3</sup>Groupon Isn’t For Everyone: Do’s and Don’ts for Small Business Owners, <http://www.nfib.com/business-resources/business-resources-item?cmsid=56739>

who are members of the daily-deal website. We refer to this increase in market reach of merchants through offering deals on the website as the *advertising* effect. Further, consumers who are unaware about the product offerings of a merchant may also underestimate the quality. This is particularly critical because daily-deal websites are popular among those businesses that offer experience goods or services like restaurants, fitness centers and beauty treatment salons. Some of the consumers who buy a product offered on a discounted price on the website may update their quality beliefs and may directly buy the product at regular price from the merchant in future. Further, many consumers may use a daily-deal website to acquire information about a new merchant, and become loyal consumer after their first experience. We refer to this increase in market share as the *sampling* effect of a daily-deal website.

Daily-deal website attracts not only new consumers but also existing consumers of a merchant who would have paid the full prices. Thus, offering deals on a daily-deal website may lead to revenue loss from merchants' existing consumers. We refer to this loss as the *cannibalization* effect. In addition, one of criticisms to the daily-deal websites' business model is that some of consumers are price sensitive and never come back to business without coupons. We refer to these consumers as the *deal seekers*.

Daily-deal websites provide a venue where business can reach out for large consumer coverage and consumers can experience the goods offered via an attractive deal. Merchants value these advertising and sampling effects of daily-deal websites differently because of their inherent heterogeneities in term of the existing proportion of *informed consumers* who know about the quality of their product offerings. For example, a newly established restaurant whose target is to convert consumers to regular clients recognizes the size of consumers who seek information on a daily-deal website. On the other hand, a spa salon whose priority is to fill up empty slots weighs more the reach for new consumers that a daily-deal website commands. On the other hand, some of the existing regular consumers of a business may buy the product on the daily-deal website. This shift of regular consumers who would have bought the product at its regular price to making purchase on the daily-deal website leads to revenue loss to the merchant. Therefore, the merchants need to balance the potential negative effect of cannibalization with positive benefits of advertising and sampling effects.

There are limited academic works which study the ecosystem of daily-deal websites. Edelman et al. (2010) develop a simple model which only captures a merchant's decision of offering a deal to two heterogeneous consumer segments and assume away any strategic actions by the website, to study the price discrimination and advertising effects of a daily-deal website. They find that it might be more profitable for less known merchants or merchants with lower marginal cost to offer deals. Byers et al. (2011) study the economics of online daily-deals to understand Groupon's operational strategy and identify an opportunity for price-based revenue optimization through purchase incentive, deal scheduling and duration, and deal featuring. Examining sentiments expressed in the popular press, Dholakia (2012) reports mixed empirical results: some business owners speak glowingly of Groupon, while others regret their online deals. Kumar and Rajan (2012) use an analytical model and data from merchants to show that profitability of offering deals on a daily-deal website depends on the discount rate, size of new consumers, and existing consumers. Some earlier studies (Anand & Aron 2003; Kauffman & Wang 2001) have examined other online group buying schemes that arose before emergence of daily-deal websites, to understand the economics of dynamic pricing. Our paper focuses on the impact of revenue sharing ratio announced by the website on merchants' participation and discount decisions.

In our setting, daily-deal website is a Stackelberg leader and merchants are followers who sell an experience good whose true quality is revealed to an *uninformed consumer* only after consumption (Nelson, 1974; Milgrom & Roberts, 1986). We develop a two-period model similar to Bilal (1989) where merchants offer discounts on the daily-deal website to first-time consumers and extract surplus in the second period. Our modeling approach is also similar to models of introductory offers of Shapiro (1983) and Bagwell (1990). Merchants are heterogeneous in proportion of *informed consumers* and consumers form a priori expectation about the quality of good based on product characteristic. This conceptualization is similar to the treatment of advertising by daily-deal websites like Groupon in Edelman et al., (2010) where some consumers are simply not aware about the merchant's existence, but is different from Shapiro (1983) where some consumers over-estimate the quality of the good. In our setting consumers consistently underestimate the quality of the good and realize the true quality only upon consumption. This is justified in our context where a merchant whose product has been overestimated by the consumers will never offer a deal. Since consumers underestimate the true quality of the product, a

daily-deal website allows a merchant to offer discounts at a different rate to consumers on the website which captures the sampling effect of the website.

We find that the merchants' participation strategy depends on the optimal discount rate strategy which in turn is driven by quality uncertainty and proportion of deal seekers in the market. In determining the optimal discount strategy merchants' tradeoff positive benefits of advertising and sampling with the negative impact on revenue due to cannibalization. Under some conditions, merchants increase the discount rate as website's revenue sharing ratio increases. Merchants with low proportion of *informed consumers* are more likely to participate even if the revenue sharing ratio is very high because they have large positive advertising benefit and relatively low loss in revenue due to cannibalization. Website's optimal revenue sharing ratio takes into account revenue from each merchant and mass of participating merchants. Since the mass of participating merchants decreases as revenue sharing ratio increases, even though revenue to the website from each merchant increases as sharing ratio increases, there exists an optimal revenue sharing ratio. Surprisingly, the revenue sharing ratio decreases as quality uncertainty decreases. We also find the support for the suggestion that it is not optimal for a daily-deal website to have a 50% revenue sharing agreement for all types of merchants with heterogeneous products and market characteristics. We also recommend that a website should also lower the revenue sharing ratio when the proportion of *deal seekers* is large.

## Model

We consider a market consisting of three types of players, a monopolist daily-deal website, a set of merchants, and a set of consumers. While daily-deal website and the merchants make strategic decisions, consumers are price-takers. The market consists of unit mass of consumers and the daily-deal website attracts  $n_C$  proportion of consumers. Among the consumers on the daily-deal website,  $\beta$  proportion of consumers are *deal seekers* who buy only when they get a deal, and  $1 - \beta$  proportion consumers are *information seekers* who may buy at regular price (without deal). The *information seekers* are attracted to the daily-deal website to try out new merchants and seek information about their offerings, while *deal seekers* are attracted to daily-deal website because they are price sensitive. The website is characterized by this exogenous parameter  $\beta \in (0,1)$ .

Merchants, who sell a homogeneous experience good of quality  $q$  which may be a product or service, are heterogeneous in terms of consumers' awareness about their product and service offerings. We denote the consumers who are aware about a merchant as *informed consumers* and those who are unaware about the merchant as *uninformed consumers*. *Informed consumers* are aware about the true quality  $q$  of the product offerings of the merchant but *uninformed consumers* have some uncertainty about the quality even when they become aware about the merchant. We denote this quality uncertainty of the *uninformed consumers* when they become aware about the merchant by  $k \in (0,1)$ , such that *uninformed consumers'* expected quality is  $E[q] = kq$ .

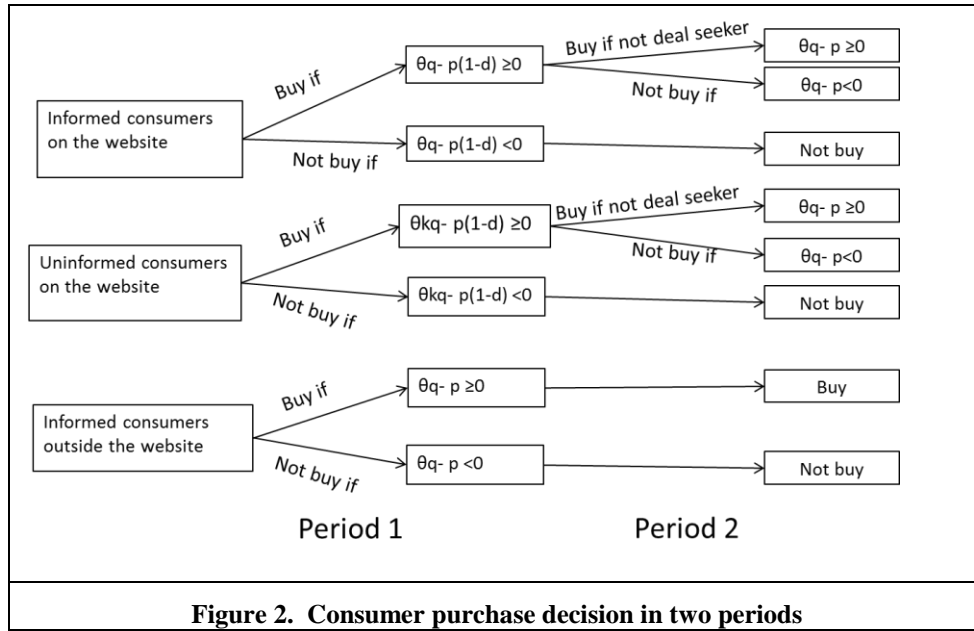
This quality uncertainty is resolved only after the consumption of the good. In other words, the parameter represents the degree of quality uncertainty of *uninformed consumers* and is likely to be different for different product or service categories. Consumers who are not aware about a spa salon and a fitness center are likely to have higher uncertainty about quality (lower  $k$ ) for spa salon compared to the fitness center. To that extent, quality uncertainty parameter  $k$  is a product specific characteristic. Further, consumers are heterogeneous in valuation of quality. The quality valuation parameter,  $\theta$ , is consumers' private information though the distribution  $\theta \sim U[0,1]$  is common knowledge.

Merchants are heterogeneous in terms of consumers' awareness about their product and service offerings. Parameter  $\delta$  captures this heterogeneity such that the proportion of *informed consumers* for a merchant of type  $\delta$  is  $\delta$  and proportion of *uninformed consumers* is  $1 - \delta$ . In other words,  $\delta$  captures the market size of a merchant in the regular market, and a merchant with higher  $\delta$  has a larger market size. Merchants' market size parameter  $\delta$  is uniformly distributed  $\delta \sim U[0,1]$  and it is merchants' private information though its distribution is common knowledge. We assume that the marginal cost of serving additional consumer of merchants is negligible and normalize the same to zero.

### Purchase decisions by consumers

We consider a two-period game. Merchants may offer deals on the daily-deal website in the first period which attracts both informed and *uninformed consumers*, and no deal is offered in the second period. Let the regular price be  $p$  and discount offered on the daily-deal website be  $d \in (0,1)$  in the first period. This implies that in the first period the price paid by a consumer who decides to buy is  $p$  in the regular market and  $p(1-d)$  on the daily-deal website, and the price paid is  $p$  by consumers who decide to buy in the second period. Note that the experience good or service is sold at the same price in the regular market in both periods and all transactions take place outside the website in the second period. Each consumer buys one good or nothing from each merchant in each period. A consumer buys the good only if he derives non-negative surplus from purchase of the good.

In the first period, there are three types of consumers. First, there are  $\delta n_c$  mass of consumers who are aware (*informed consumers*) about a merchant of type  $\delta$  and are also on the website. Second, there are  $\delta(1-n_c)$  mass of consumers who are aware about a merchant of type  $\delta$  but are not on the website. Third, there are  $(1-\delta)n_c$  mass of consumers who were not aware about a merchant of type  $\delta$  but are on the website. Note that  $(1-\delta)(1-n_c)$  mass of consumers is neither on the website nor were informed about the merchant and are not making any purchase decisions.



The *informed consumers* whether on the website or not know the true quality  $q$  of merchant's product offerings. On the other hand, consumers who are on the daily-deal website, but were *uninformed* have the *a priori* expectation of quality  $E[q] = kq$ . Thus, a consumer's utility from buying the experience good in the first period is:

$$U_1(\theta) = \begin{cases} \theta q - p & \text{informed consumers outside the website} \\ \theta q - p(1-d) & \text{informed consumers on the website} \\ \theta k q - p(1-d) & \text{uninformed consumers on the website} \end{cases}.$$

Consumers who have non-negative utility in the first period buy the experience good. *Uninformed consumers* who buy the experience goods in the first period on the daily-deal website update the quality expectation to true quality after consumption. Note that  $\beta$  proportion of consumers on the website (*informed or uninformed*) are *deal seekers* and they do not buy the good at the regular price in the second

period. Thus, a non-*deal seeker* consumer's utility from buying the experience good in the second period is:

$$U_2(q, \theta, k, p) = \begin{cases} \theta q - p & \text{informed consumers and uninformed consumer who bought in first period} \\ \theta k q - p & \text{uninformed consumer who did not buy in first period} \end{cases}$$

Figure 2 provides a detailed decision tree of consumers in the two periods.

### Daily-deal Website

The daily-deal website offers a revenue sharing contract to merchants and takes a  $s$  fraction of the revenue generated on the website. The strategic interaction between the website and the merchants is a leader-follower game, where the daily-deal website is leader and merchants are followers. After the website announces revenue sharing ratio  $s$ , merchants decide to (i) offer a deal on the website or not, and (ii) discount rate  $d$ . When a merchant of type  $\delta$  offers a deal on the website, then it pays  $s$  proportion of revenue to the website in the first period from the revenue generated from *informed* and *uninformed consumer* who transact on the website in the first period.

The profit of offering a deal on the daily-deal website for a merchant type  $\delta$  consists of net revenues from *informed* and *uninformed consumers* in two periods. In the first period, the price on the website after discount is  $p(1-d)$  and the merchant get only  $p(1-d)(1-s)$  after revenue sharing with the website. Let the demand proportions of *informed* and *uninformed consumers* on the website in the first period be  $D_{li}^w$  and  $D_{lu}^w$ , and demand proportion from *informed consumer* in the regular market in the first period be  $D_{li}^o$ . Then given that  $\delta n_c$  and  $(1-\delta)n_c$  are *informed consumers* on the website and  $\delta(1-n_c)$  are *informed consumers* outside the website, the first period profit of a merchant of type  $\delta$  who offers a discount  $d$  on the daily-deal website is:

$$\pi_{1M} = \delta n_c D_{li}^w p(1-d)(1-s) + (1-\delta)n_c D_{lu}^w p(1-d)(1-s) + \delta(1-n_c) D_{li}^o p \quad (1)$$

, where the  $D_{li}^w = (1 - \frac{p(1-d)}{q})$ ,  $D_{lu}^w = (1 - \frac{p(1-d)}{kq})$ , and  $D_{li}^o = (1 - \frac{p}{q})$ .

Note that *uninformed consumers* who are not on the website are not aware about the merchant and do not buy. In the second period, merchants do not offer any discount and only those consumers who get positive utility and are not *deal seekers* buy. Let the demand of *informed* and *uninformed consumers* in the second period who did the transaction on the website in the first period be  $D_{2i}^w$  and  $D_{2u}^w$ , and who transacted in the regular market in the first period be  $D_{2i}^o$ . Then given that only  $1-\beta$  proportion (*information seekers*) of those consumers who are on the website in the first period consider buying in the second period, the profit of a  $\delta$  type merchant in the second period is:

$$\pi_{2M} = \delta n_c (1-\beta) D_{2i}^w p + (1-\delta)n_c (1-\beta) D_{2u}^w p + \delta(1-n_c) D_{2i}^o p \quad (2)$$

Hence the profit of a  $\delta$  type merchant in the two periods who offers discount  $d$  on a daily-deal website which allows has revenue sharing ratio of  $s$  is:

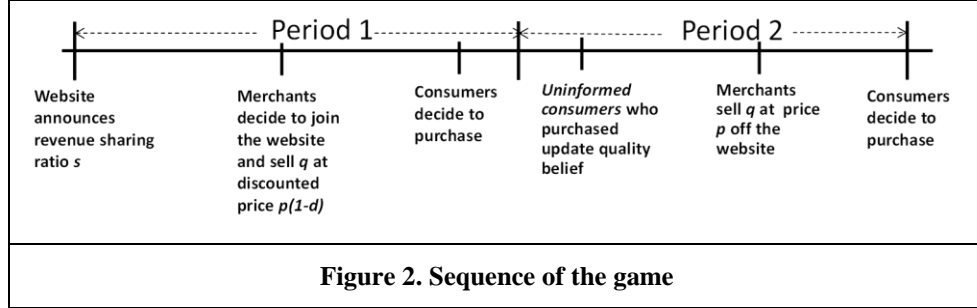
$$\pi_M = \pi_{1M} + \pi_{2M} \quad (3)$$

And the daily-deal website's revenue function is:

$$\pi_W = s \int_0^1 (\delta n_c D_{li}^w p(1-d) + (1-\delta)n_c D_{lu}^w p(1-d)) d\delta \quad (4)$$

Note that when a merchant decides not to participate on the website, then  $D_{li}^w = 0$  and  $D_{lu}^w = 0$  in (4).

Note that the discount  $d$  offered by a merchant of type  $\delta$  may depend on the revenue sharing proportion announced by the daily-deal website. Some merchants of certain types may not offer a deal on the website, and their revenue on the website is zero. Figure 2 describes the sequence of the two-period and Table 1 provides summary of notations.



| Table 1. Summary of Notation                                    |   |
|---|---|
| $\delta$ proportion of <i>informed consumers</i> for a merchant | $\pi_{tM}$ merchant's profit from consumers outside the website in period $t$                 |
| $n_C$ proportion of consumers on the website                    | $D_{ti}^w$ merchant's demand from <i>informed consumers</i> on the website in period $t$      |
| $\beta$ proportion of <i>deal seekers</i> on the website        | $D_{tu}^w$ merchant's demand from <i>uninformed consumers</i> on the website in period $t$    |
| $\theta$ consumer valuation for quality                         | $D_{ti}^o$ merchant's demand from <i>informed consumers</i> outside the website in period $t$ |
| $k$ <i>uninformed consumers'</i> quality uncertainty            | $\pi_W$ daily-deal website's revenue over two periods from participating merchants            |
| $q$ true quality of experience goods                            |   |
| $p$ merchants' regular price                                    |   |
| $d$ discount rate on the website in the first period            |   |
| $s$ daily-deal website's revenue sharing ratio                  |   |

## Merchants' Discount and Participation Decision

Offering deals on the daily-deal website allows merchants to access *uninformed consumers* who are on the website but were not aware about the merchants' offering of the experience good. This increases the market size of the merchants and we characterize this as the advertising effect of the daily-deal website. This effect has positive impact on the merchants' revenue and depends on the proportion of consumers who are on the website  $n_C$ , and the proportion of the *uninformed consumers*  $(1-\delta)$  for a merchant of type  $\delta$ . The advertising effect is stronger if the website has a larger consumer base (higher  $n_C$ ) or the merchant has lower proportion of *informed consumers* (lower  $\delta$ ).

*Uninformed consumers*, who are exposed to the merchants on the website, have uncertainty about the quality of the experience good. Merchants offer deals or discounts off the regular price to induce these *uninformed consumers* with quality uncertainty to try in the first period, and then buy at the regular price in the second period. The daily-deal website can be thought of as an intermediary who distributes merchants' digital deals to consumers on the website in the first period. We characterize this effect of inducing *uninformed consumer* to try out the good in the first period as the sampling effect. The strength of the sampling effect depends on the discount rate offered by the merchants. Further, merchants decide the optimal discount rate by taking into account the quality uncertainty  $k$ , the proportion of deal seekers  $\beta$  and the revenue sharing ratio  $s$ .

Offering deals on the daily-deal website also introduces two type of risks to the participating merchants. One risk is that merchants incur loss of revenue from the *informed consumers* who would have bought the good at the regular price but now buy at the discounted price on the website in the first period. We characterize this as the cannibalization effect. The scale of this cannibalization effect depends on the proportion of *informed consumers*  $\delta$ , the proportion of consumers in the market who are on the website  $n_c$ , and discount rates offered by the merchants  $d$ . The cannibalization effect becomes more severe for a merchant with higher proportion of *informed consumers* (higher  $\delta$ ) or when larger proportion of market are on the website (higher  $n_c$ ), or merchants offer higher discount rates (higher  $d$ ).

Another risk to the merchants who offer deals on the website is that when *informed consumers* observe a merchant offering deal on the website, then they expect that the merchant will offer deals on the website in the future, and thus, may not buy at the regular price in the second period. Moreover, some of the *uninformed consumers* who are on the website may be highly price sensitive or expect the merchant to offer deals in the future, and may not buy at the regular price in the second period. This risk is captured by the parameter  $\beta$ . This is the proportion of consumers who are deal seekers and have no intention of making a repeat purchase at regular price in the second period. This risk may reduce the gain of revenue from the *uninformed consumers* on the website and therefore may reduce the positive benefit of the sampling and advertising effect to the participating merchants. In addition to this, this risk may increase the loss of revenue to the *informed consumers* for offering deals on the website. Note that, this negative impact of offering deals on the website is in the addition to the cannibalization effect discussed above.

Merchants also need to take into consideration the daily-deal website's announced revenue sharing ratio  $s$ . A higher revenue sharing ratio implies merchants are asked to pay a greater fraction of the revenue of deals in the first period. This revenue includes all deals sold to both *informed* and *uninformed consumers* on the website in the first period. Note that any increase in  $s$  may decrease the positive benefit of advertising and sampling effect and may increase the negative impact of cannibalization effect.

In this setting, the daily-deal website first announces the revenue sharing ratio  $s$ , and merchants react to that announcement, and decide whether to offer deals on the website and the discount rate if they decide to offer deals. In deciding the optimal revenue sharing ratio, the website needs to take into consideration the response of merchants and hence, we first analyze merchants' discount and participation strategy.

### **Benchmark case: No deal offered on the website**

Before examining the merchants' discount and participation strategy on the website, we establish the benchmark case where merchants do not offer deals on the website. In order words, what is the optimal revenue of a  $\delta$  type merchant in the regular market where there is no daily-deal website?

Since only the *informed consumers* know about the true quality of the experience good and merchant, a  $\delta$  type merchant's revenue function over the two periods is:

$$\pi_B(p) = \delta(D_{1i} + D_{2i})p$$

where  $D_{1i}$  and  $D_{2i}$  is demand proportion from the *informed consumers* ( $\delta$  proportion of the mass of consumers) in the first and the second period. Note that since the *uninformed consumers* do not know about the product offerings of the merchant, hence they do not buy. Therefore, the merchant's revenue function does not include demand from the *uninformed consumers* in the benchmark case.

A consumer who has  $\theta$  valuation for quality buys the good in the first period if  $\theta q - p \geq 0$ . Hence, all consumers who have  $\theta \geq (p/q)$  buy the good in the first period. More formally,  $D_{1i} = 1 - F(p/q)$  where  $F(\cdot)$  is cumulative density function. Since  $\theta$  is uniformly distributed, we have  $D_{1i} = 1 - p/q$ . Since the *informed consumers* know the true quality of the good, they do not update the quality in the second period and all consumers who buy in the first period also buy in the second period. Hence,  $D_{2i} = D_{1i}$ . Now, we can rewrite the merchant's revenue function over the two periods as:

$$\pi_B(p) = 2\delta(1 - p/q)p \quad (5)$$



A merchant of type  $\delta$  maximizes revenue in (5) by choosing optimal price  $p$ . Solution to the merchant's optimization problem gives the optimal price, demand in two periods and profit as:

$$p^* = q/2, D_{1i} = D_{2i} = 1/2, \pi_B^* = q\delta/2$$

### Merchants offer deals on daily-deal website

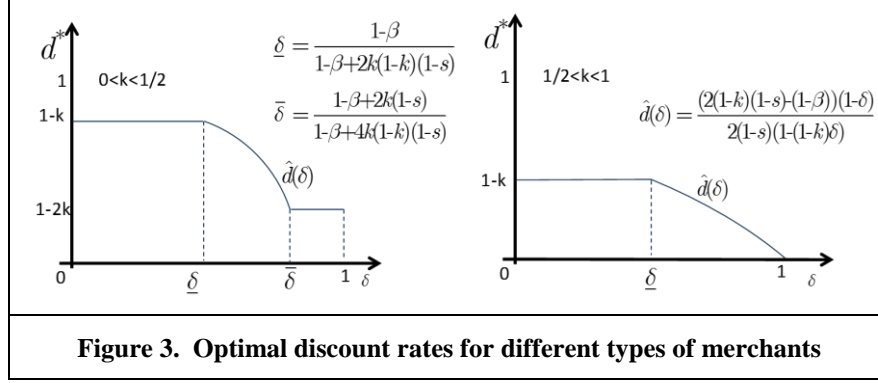
Merchants offer deals on the daily-deal website to access *uninformed consumers* and offer deals to induce them to buy in the first period at a discounted price, and after realizing the true quality, buy at the regular price in the second period. Advertising effect and sampling effect have positive impact on merchants' revenue. However, merchants also are exposed to risks of revenue loss from the *informed consumers* on the website in the first period due to cannibalization effect, and in the second period due to the deal seeking behavior among consumers on the website. Thus merchants make the trade-off between the positive and negative effects of offering deals on the website to determine the optimal discount rate. Merchants participate on the daily-deal website if and only if they have higher revenue from participation than the benchmark case,  $\pi_M^* > \pi_B^* = q\delta/2$ .

Merchants offer discount off the regular price on the daily-deal website in the first period. The regular prices charged by merchants in both periods remain the same. *Informed consumers* who are not on the website make their purchase decision taking into consideration the regular price in the first period. In other words, merchants commit to a price in both periods (Edelman 2011). Merchants do not offer any discount or deal in the second period and hence, the optimal regular price is the same as in the benchmark case,  $p = q/2$ .

There are two types of consumers on the website, informed and *uninformed consumers*. The *informed consumers* know the quality of the good  $q$ , and the *uninformed consumers* expect the quality to be  $kq$ . Since merchants offer discount off the regular price on the website, the demand proportion of the good from the *informed consumers* on the website in the first period is  $D_{1i}^W > D_{1i} = 1/2$ . Moreover, the demand proportion for the good from the *uninformed consumers* on the website in the first period is also driven by the discount rate. On the other hand, demand proportion from the *informed consumers* in the second period is the same as in the benchmark case  $D_{2i}^W = D_{2i} = 1/2$ , because the valuation of *informed consumer* remains the same in both periods. The demand proportion from the *uninformed consumers* in the second period depends on the discount rate offered in the first period, but can never be larger than the demand proportion in the benchmark case  $D_{2u}^W \leq D_{2i} = 1/2$ , because the merchants charge the regular price in the second period. In other words,  $0 \leq D_{2u}^W \leq 1/2$ .

Therefore, merchants will not set discount rates higher than what is required to induce the *uninformed consumers* to would buy at the regular price if they knew the true quality. Given that, the demand for the *uninformed consumers* in the second period is  $D_{2u}^W = (1 - p(1 - d) / kq)$ . Since  $0 \leq D_{2u}^W \leq 1/2$ , hence,  $0 \leq (1 - p(1 - d) / kq) \leq 1/2$ . By simplifying this inequality, we get (i) when  $k < 1/2$ , then the optimal discount rate is  $d^* \in [1 - 2k, 1 - k]$ , and (ii) when  $k \geq 1/2$ , then  $d^* \in [0, 1 - k]$ . Proposition 1 describes optimal discount strategy of merchants with different proportion of *informed consumers* ( $\delta$ ).

**PROPOSITION 1:** For any given revenue sharing ratio  $s$  announced by the website, (i) the merchants offer discount rate  $d^* = 1 - 2k$  when  $k < 1/2 \cap \delta \geq \bar{\delta}$ ; (ii) the merchants offer discount rate  $d^* = \hat{d} \in ((1 - 2k), (1 - k))$  when  $k < 1/2 \cap \delta \in (\underline{\delta}, \bar{\delta})$ ; (iii)  $d^* = \hat{d} \in [0, (1 - k))$  when  $k \geq 1/2 \cap \delta \in (\underline{\delta}, 1]$ ; and (iv) the merchants offer discount rate  $d^* = 1 - k$  when  $\delta \leq \underline{\delta}$ .



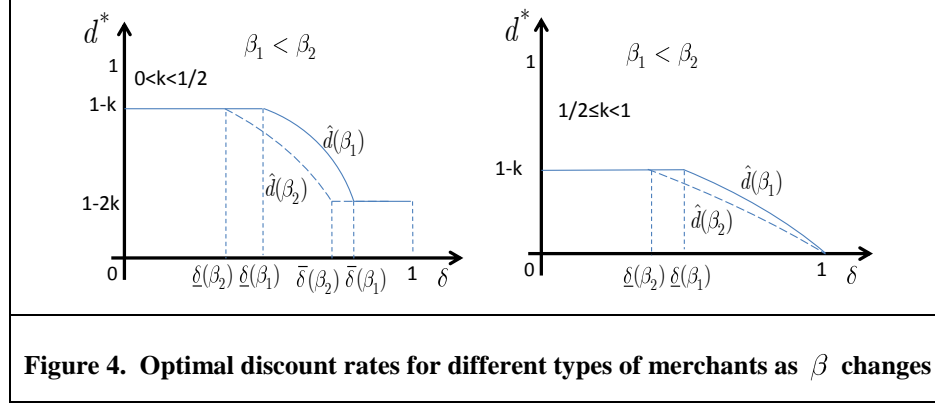
Proposition 1 outlines the optimal discount rates of merchants for any given quality uncertainty parameter of *uninformed consumers*  $k$ , the proportion of *deal seekers*  $\beta$  and the website's announced revenue sharing ratio  $s$ . Irrespective of quality uncertainty parameter  $k$ , merchants with relatively lower  $\delta$  ( $\delta \leq \underline{\delta}$ ), that is with lower proportion of *informed consumers* in the market, offer largest discount rate of  $1-k$ , if they offer deals on the website. When there is large quality uncertainty, that is  $k < 1/2$ , then merchants with moderate proportion of *informed consumers*, that is  $\underline{\delta} < \delta < \bar{\delta}$ , reduce the discount rate as proportion of *informed consumers* increases and all merchants with relatively higher  $\delta$  ( $\delta \geq \bar{\delta}$ ) offer the lowest optimal discount rate of  $1-2k$  on the website (Left panel, Figure 3). When  $k \geq 1/2$ , then no merchant offers  $1-2k$  discount rate (Right panel, Figure 3).

When merchants' proportion of *informed consumers* ( $\delta$ ) increases the potential revenue gain from the advertising effect decreases. It is because the proportion of *uninformed consumers* ( $1-\delta$ ) on the website decreases. The revenue loss due to the cannibalization effect increases, because the proportion of information consumers on the website ( $n_c\delta$ ) increases. Therefore, merchants with higher  $\delta$  offer lower discount on the website when they make the trade-off between cannibalization effect and advertising effect. On the other hand, merchants with relatively low ( $\delta < \underline{\delta}$ ) have lower cannibalization effect and higher benefit from advertising effect. Therefore, these merchants offer the highest discount rate  $d=1-k$  to achieve optimal benefit of sampling effect. Note that, merchants never offer discount rates higher than  $d=1-k$ . It is because by offering higher discount rates than  $1-k$ , merchants do not gain additional revenue from the *uninformed consumers* in the second period, but get sub-optimal revenue in the first period from them.

In the case where *uninformed consumers'* quality uncertainty is high ( $k < 1/2$ ), it is unprofitable to offer a low discount rate ( $d \leq 1-2k$ ). It is because by offering a discount rate  $d \leq 1-2k$ , merchants cannot attract any *uninformed consumers* to buy in the first period and therefore, derive no revenue gain in the second period. But the merchants experience loss from *informed consumers* in the first period due to cannibalization. Furthermore, it is easy to see that the minimum discount rate  $d=1-2k$ , increases if the  $k$  decreases. This finding provides support to the observed business practice of offering high discount rates on daily-deal website for experience goods which may have level of quality uncertainty, like spa salon and beauty treatment services.

Merchants' optimal discount rate is impacted by the proportion of deal seekers on the daily-deal website which limits the revenue gain from consumers in the second period. The revenue sharing ratio announced by the website also affects merchants' revenue in the first period. In the next two propositions, we discuss the impact of these two factors on the merchants' optimal discount rate strategy.

**PROPOSITION 2:** For any given revenue sharing ratio  $s$  announced by the website, as the proportion of deal seekers  $\beta$  increases, (i) the lower merchant type  $\underline{\delta}$  decreases for all  $k$ , and when  $k < 1/2$  then the upper merchant type  $\bar{\delta}$  also decreases; and (ii) discount rate offered by merchants of relatively high  $\delta$  or low  $\delta$  remains the same, but merchants with intermediate  $\delta$  lower the discount rate.

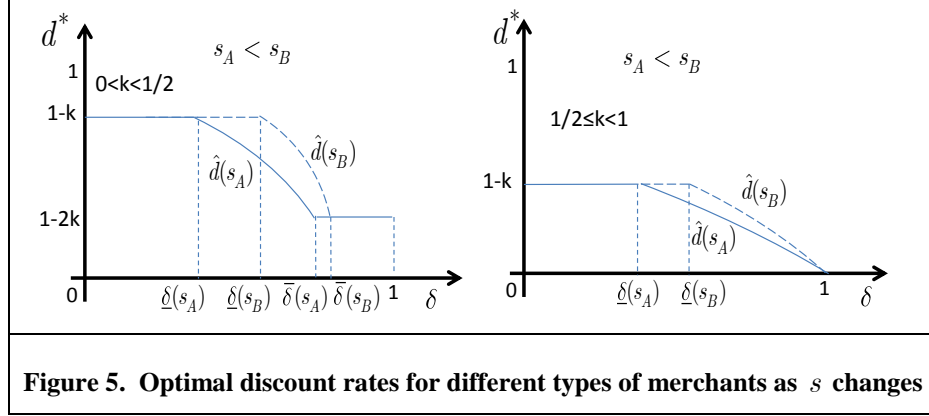


The proportion of deal seeking consumers on the daily-deal website affects merchants' profitability of offering deals on the website. When the proportion of deal seekers who do not buy at the regular price in the second period increases, the potential revenue gain from the *uninformed consumers*, that is, the positive sampling effect decreases. In addition, revenue loss from the *informed consumers*, that is, the cannibalization effect worsens as more *informed consumers* turn to deal seekers and do not buy at the regular price in the second period. As the proportion of deal seekers increases, merchants with higher proportion of *informed consumers* are impacted more severely and they reduce the discount rate to save revenue loss from the cannibalization effect. Note that when  $k < 1/2$ , then merchants lower discount rate bounded by  $1 - 2k$  (Proposition 1). Merchants who have relatively low proportion of *informed consumers*, have very high benefit from the advertising and sampling effect, and therefore, they do not change their optimal discount rate ( $1 - k$ ). However, the lower merchant type  $\underline{\delta}$  shifts to the left (Figure 4).

**PROPOSITION 3:** For any given proportion of deal seekers  $\beta$ , as the revenue sharing ratio  $s$  announced by the website increases, (i) the lower merchant type  $\underline{\delta}$  increases for all  $k$ , and when  $k < 1/2$  then the upper merchant type  $\bar{\delta}$  also increases; and (ii) discount rate offered by merchants of relatively high  $\delta$  or low  $\delta$  remains the same, but merchants with intermediate  $\delta$  increase the discount rate.

Higher revenue sharing ratio announced by the daily-deal website reduces merchants' profitability of offering deals on the website. And to that extent, the effect of increase in revenue sharing ratio on merchants' discount strategy is similar to the effect of increase in the proportion of deal seekers described in Proposition 2. The key difference between the impact of increase in  $\beta$  and increase in  $s$  is that increase in  $\beta$  impacts merchants' revenue in the second period, but increase in  $s$  impacts merchants' revenue in the first period. Interestingly, when the website increases the revenue sharing ratio, the merchants who have higher proportion of *informed consumers* increase the discount rate offered on the website with the permissible bound given in the Proposition 1. Further, as revenue sharing ratio increases, the lower merchant type  $\underline{\delta}$  shifts to the right. This implies that more merchants offer the highest discount rate  $1 - k$  (Figure 5).

The economic intuition for this result is as follows. Merchants maximize revenue over the two periods by offering discount on the website taking into consideration the advertising, the sampling and the cannibalization effects, and revenue loss from deal seekers in the first period. When merchants pay a higher share of revenue to the website, their concern about the revenue loss from the *informed consumers*, that is, the cannibalization effect is reduced in the first period. Therefore, merchants offer higher discount rate to induce more *uninformed consumers* in the first period. Conversely, as the proportion of deal seekers ( $\beta$ ) increases, merchants' benefit from *uninformed consumers* in the second period, that is, the sampling effect diminishes. It drives merchants to offer lower discount rate to reduce the cannibalization effect in the first period.



### Merchant's participation decision

Recall that only those merchants whose profit is higher than the benchmark revenue,  $\pi_M^* > \pi_B^* = q\delta / 2$ , will offer deals on the daily-deal website. In the next proposition We will examine the impacts of quality uncertainty  $k$ , the proportion of deal seeker  $\beta$  and the revenue sharing ratio  $s$  on the merchants' decision to participate on the website. The merchants' participation decision has key impact on the website's revenue and, hence, on the website's optimal revenue sharing ratio.

**PROPOSITION 4:** *When the daily-deal website announces zero revenue sharing ratio  $s = 0$ , then there exists a threshold merchant type  $\hat{\delta} < 1$  such that any merchant of type  $\delta > \hat{\delta}$  does not participate on the website. As revenue sharing ratio  $s$  or proportion of deal seekers  $\beta$  increases, the threshold merchant type  $\hat{\delta}$  decreases.*

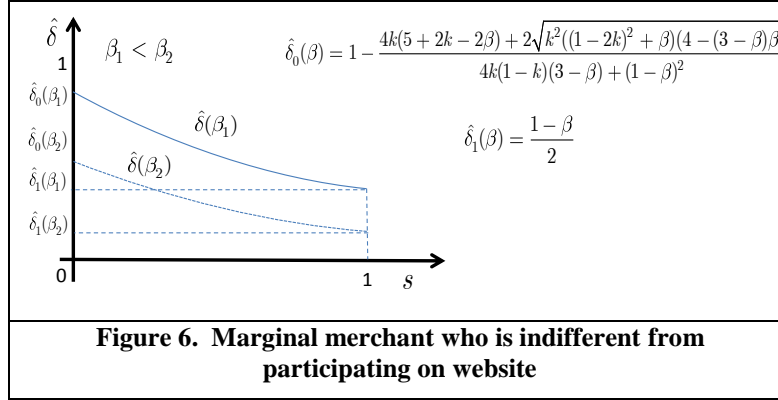
Merchants decide to participate on the daily-deal website only when their profit from participating is more than the benchmark revenue. Proposition 4 highlights that even when the website does not take any revenue share from merchants, only those merchants who have proportion of *informed consumers* below a critical value  $\delta < \hat{\delta}$  offer deals on the website. It is because merchants with high  $\delta$  have more revenue loss from cannibalization effect and the deal seeking behavior of *informed consumers* than revenue gain from advertising and sampling effect of the *uninformed consumers* on the website. The marginal merchant type  $\hat{\delta}$  is the one whose revenue loss from participation equals revenue gain from participation. Note that, as  $\delta$  increases, merchants' revenue loss from participation increases and revenue gain from participation decreases.

This lends support to some industry experts' argument that daily-deal websites are only appealing to certain types of merchants, and not to all. In fact, some merchants who are relatively well known may incur too much revenue loss due to cannibalization, which may be more than the gain from the *uninformed consumers*. Thus, they will not offer deals on the daily-deal website even if website charges no fee. It highlights that the economics of the daily-deal website is such that it has potential to attract a specific group of relatively less known merchants.

As the website increases the revenue sharing ratio (higher  $s$ ), the revenue gain from participation to merchants of any type decreases, while the revenue loss due to cannibalization remains the same even if merchants does not increase the discount rate. From Proposition 3, we know that as  $s$  increases, the merchants either offer the same discount rate or increase discount rate. It implies the revenue loss due to cannibalization may even increase as  $s$  increases. Therefore, the marginal merchant type who participates on the website decrease as  $s$  increases (Figure 6). It implies that fewer merchants, whose  $\delta \in [0, \hat{\delta}]$ , participate on the website as  $s$  increases.

The impact of increase in proportion of deal seekers on the website is similar to the trade-off of revenue gain and loss for merchants as in the case of increase in revenue sharing ratio. For any given  $s$ , as  $\beta$

increases, the net benefit to merchants from participating on the website decreases (Proposition 2). Hence, the marginal merchant type who participates on the website decreases as  $\beta$  increases.



Note that the merchants' profit decreases when revenue sharing ratio increases. Therefore, the number of merchants, who offer deals on website, decreases as  $s$  increases. This suggests that even if the daily-deal website has power to decide revenue sharing ratio for merchants, the website revenue may not be monotonically increasing in revenue sharing ratio  $s$ .

**COROLLARY 1:** When revenue sharing ratio  $s = 1$ , then  $\hat{\delta} = (1 - \beta) / 2$ .

In a limiting case where the daily-deal website sets the revenue sharing ratio at  $s = 1$ , some merchants  $\delta < \hat{\delta} = (1 - \beta) / 2$  will still offer deals on the website. It is because for those merchants, the revenue gain from *uninformed consumers* who buy in the second period is more than the revenue loss from all the *informed consumers* who are on the website. Note that, this trade-off of the marginal merchant between revenue gain and revenue loss depends only on the proportion of deal seekers on the website as highlighted in Corollary 1.

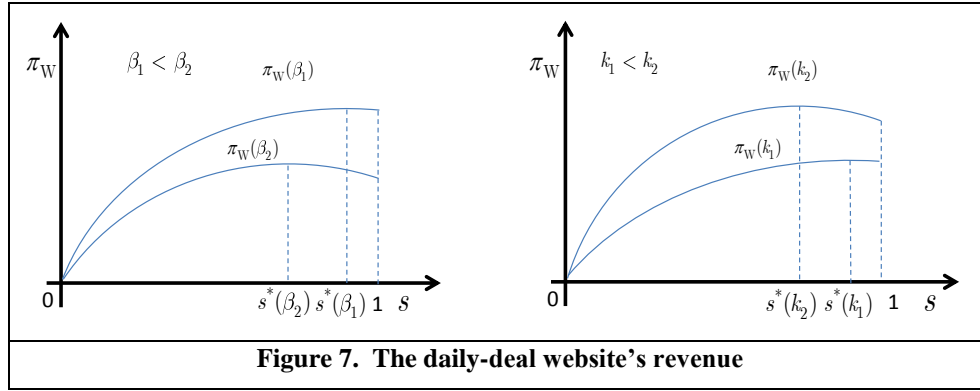
Corollary 1 highlights the role of the daily-deal website as an effective advertising and sampling intermediary, especially to merchants who have lower proportion of *informed consumers*. Even when merchants' payout is all the revenue generated on the website in the first period, some merchants will offer deals on the website.

**PROPOSITION 5:** There exists a critical revenue sharing ratio  $\tilde{s}$  such that if  $s \geq \tilde{s}$ , then all merchants who offer a deal on the website, offer the highest discount rate  $d^* = 1 - k$  and  $\hat{\delta} \leq \underline{\delta}$ .

Merchants' minimum discount rate is  $\max[0, 1 - 2k]$  (Proposition 1). When the website increases the revenue sharing ratio, the marginal merchant type who offers deal on the website decreases (Proposition 4). From Proposition 3, we know that as  $s$  increases, the lower merchant type  $\underline{\delta}$  increase. Therefore, the impact of any increase in  $s$  is that the  $\underline{\delta}$  increases and the  $\hat{\delta}$  decreases. Hence, there exists some  $\tilde{s}$  for which  $\underline{\delta} = \hat{\delta}$ . This implies that for any revenue sharing ratio  $s \geq \tilde{s}$ , all merchants who offer deals on the website, offer the highest discount rate  $d^* = 1 - k$ . This discount rate is independent from merchants' types, website's revenue sharing ratio, and the proportion of deal seekers on the website. This may explain why we observe homogenous high discount rates on daily-deal websites offered by the merchants selling similar experience goods which are likely to have the same quality uncertainty ( $k$ ).

## Daily-deal Web Revenue Sharing Ratio

**PROPOSITION 6:** There exists an optimal revenue sharing ratio  $s^*$  that maximizes daily-deal websites revenue. The optimal revenue sharing ratio decreases as proportion of deal seekers  $\beta$  increases or quality uncertainty parameter  $k$  increases.



As the daily-deal website increases revenue sharing ratio, the revenue from each merchant who participates increases, but fewer merchants offer deals on the website (Proposition 4). Since the revenue of the website is a product of revenue from each merchant and the mass of merchants who participate, there exists an optimal revenue sharing ratio ( $s^*$ ) which maximizes the revenue of the website (Figure 7).

When the proportion of deal seekers on the website is higher, merchants' potential gain from *uninformed consumers* in the second period decreases, thus profitability of offering deals on the website decreases. This leads to lower mass of merchants who participate on the website (Proposition 4). Hence, the website's revenue decreases for any given revenue sharing ratio. Therefore, the daily-deal website decreases the revenue sharing ratio to increase the mass of merchants who participate on the website. This leads to decrease in optimal revenue sharing ratio as  $\beta$  increases (Left plot in Figure 7).

Optimal revenue sharing ratio of the website also depends on quality uncertainty of *uninformed consumers* on the website. When quality uncertainty is low (high  $k$ ), merchants offer a lower discount rate and consequently revenue loss due to *informed consumers* on the website in the first period, that is, the cannibalization effect is low. Thus, more merchants offer deals on the website and also offer lower discount rate. This implies that for any given revenue sharing ratio, the daily-deal website's revenue increases as  $k$  increases. However, counter-intuitively, the optimal revenue sharing ratio for the website decreases as  $k$  increases. This is because the loss of the revenue from each merchant by lowering  $s$  is over compensated by the gain in revenue from larger mass of merchants who offer deals on the website.

## Discussion

In this paper, we study the dynamics of merchants' discount strategy on a daily-deal website and how the website's revenue sharing agreement affects merchants' and the website's profitability. We find that website is relatively more attractive to the less known merchants. This is because these less known merchants have less concern about revenue loss from the *informed consumers* that is, low cannibalization effect and have greater revenue gain from the *uninformed consumers*, that is, large positive advertising and sampling effect. We also show that merchants' optimal discount rate depends on the proportion of deal seekers on the website, the quality uncertainty, and the announced revenue sharing ratio by the website.

The optimal discount rates offered by merchants are bounded in a range. Merchants do not get the maximum gain in revenue from *uninformed consumers* if the discount rate is not comparable to their quality uncertainty. Moreover, both merchants and the website are more profitable when the proportion of deal seekers decreases or the *uninformed consumers*' uncertainty about the merchants' quality decrease. However, the website's optimal revenue sharing ratio increases when the proportion of deal seekers decreases, but decreases when the *uninformed consumers*' uncertainty about the product quality decreases.

Our results offer some insights on daily-deal website industry. One of managerial recommendation is that the daily-deal website should reduce the new consumers' uncertainty about the quality of the experience goods. It may be achieved by providing consumer reviews about the merchants or through some quality

assurance certification. Another managerial recommendation is that the daily-deal website should have customized contract with merchants. We show that the merchants' incentive to offer a deal depends on the merchant's type and it is optimal for the website to have customized contract according to merchants' characteristics. We also recommend that the website should allow merchants to offer customized discount rates operating in different consumer demographics which may have different proportion of deal seekers.

Our stylized two-period game has some limitations. We do not consider the competition effect on daily-deal websites' strategy. Competition between rival daily-deal websites may potentially lower websites' revenue sharing ratio. This may encourage more merchants to offer deals on the websites that offers lower revenue sharing ratio. This lowering of revenue sharing ratio may induce merchants to offer higher discount rates. Furthermore, we can study the daily-deal website's the impact of membership fee structure on its optimal fixed fee contract on transactions by the merchants. Finally, in our model all *uninformed consumers* under-estimate the quality. Modeling a market where some *uninformed consumers* underestimate the quality while some others over-estimate the quality, may be a fruitful avenue for future research.

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## Appendix A: Proofs of Propositions

### Proof for Proposition 1:

From Equation 3, and consumer valuation for quality  $\theta \sim U[0,1]$ , and consumers buy if they derive non-negative utility. Therefore,  $D_{li}^w = 1-p(1-d)/q$ ,  $D_{lu}^w = 1-p(1-d)/(kq)$ ,  $D_{li}^o = 1-p(1-d)/q$  for the first period. The second period demand proportion for the *informed consumers* are the same as the benchmark case,  $D_{2i}^w = 1/2$  and  $D_{2i}^o = 1/2$ , but the demand proportion for the *uninformed consumers* depends on the discount rate in the first period: when  $1 - 2k \leq d \leq 1 - k$ , then  $D_{2u}^w = 1-p(1-d)/(kq)$ ; when



$0 \leq d < 1 - 2k$ , then  $D_{2u}^w = 0$ ; when  $1 - k < d \leq 1$ , then  $D_{2u}^w = 1/2$ . Substitute these demand proportion into Equation 1,2, and 3, we can solve the merchants' maximizing profit problem w.r.t discount rate ■

**Proof for Proposition 2 and Proposition 3:**

From Proposition 1, we have  $\underline{\delta} = \frac{1 - \beta}{1 - \beta + 2k(1 - s)(1 - k)}$  and  $\bar{\delta} = \frac{1 - \beta + 2k(1 - s)}{1 - \beta + 4(1 - k)k(1 - s)}$ . We

take derivative of  $\underline{\delta}$  with respect to  $\beta$  and  $s$ , and we have  $\frac{d\underline{\delta}}{d\beta} = \frac{-2(1 - k)k(1 - s)}{(1 + 2(1 - k)k(1 - s) - \beta)^2}$  and

$\frac{d\underline{\delta}}{ds} = \frac{2(1 - k)k(1 - \beta)}{(1 + 2(1 - k)k(1 - s) - \beta)^2}$ . Since  $1 - k > 0$ ,  $1 - \beta > 0$  and  $1 - s > 0$ , then we have  $\frac{d\underline{\delta}}{d\beta} < 0$

and  $\frac{d\underline{\delta}}{ds} > 0$ . Take derivative of  $\bar{\delta}$  with respect to  $\beta$  and  $s$ , we have  $\frac{d\bar{\delta}}{d\beta} = \frac{-2k(1 - 2k)(1 - s)}{(1 + 4(1 - k)k(1 - s) - \beta)^2}$

and  $\frac{d\bar{\delta}}{ds} = \frac{2k(1 - 2k)(1 - \beta)}{(1 + 4(1 - k)k(1 - s) - \beta)^2}$ . When  $1 - 2k > 0$ ,  $1 - \beta > 0$  and  $1 - s > 0$ , then we have

$\frac{d\bar{\delta}}{d\beta} < 0$  and  $\frac{d\bar{\delta}}{ds} > 0$ .

Between  $\underline{\delta} < \delta < \bar{\delta}$ ,  $d^* \delta = \hat{d} = \frac{(2(1 - k)(1 - s) + (1 - \beta))(1 - \delta)}{2(1 - s)(1 - (1 - k)\delta)}$ . Take derivative of  $\hat{d}$  with

respect to  $\beta$  and  $s$ , we have  $\frac{d\hat{d}}{d\beta} = \frac{1 - \delta}{2(1 - s)(-1 + (1 - k)\delta)} < 0$  and  $\frac{d\hat{d}}{ds} = \frac{(1 - \beta)(1 - \delta)}{2(1 - s)(1 - (1 - k)\delta)} > 0$ .

We prove Proposition 2 and 3 ■

**Proof for Proposition 4 and Corollary 1:**

From Proposition, we can get the merchants' optimal profit of offering deals on the website,  $\pi_M^* = \pi_M(d^*)$ . Merchants then decide whether to participate in the daily-deal website if only if  $\pi_M^* > \pi_B^*$ . Given an announced revenue sharing ratio,  $s$ , we can solve for the marginal merchant whose profit of offering deals is the same as the benchmark case,  $\hat{\delta}$  is solution to  $\pi_M^*(\hat{\delta}, s) = \pi_B^*$ . Since, merchants' discount rate depends relative magnitude of  $\delta$  with respect to  $\underline{\delta}$  and  $\bar{\delta}$ , we have, where  $s \leq \tilde{s}$

$$\hat{\delta} = 1 - \frac{4k(-1 + s)(5 + 2k - 2\beta) + 2\sqrt{k^2(-1 + s)(-1 + 4(-1 + k)k(-1 + s) - \beta)(4 + s(-3 + \beta) + (-3 + \beta)\beta)}}{4k(1 - k)(3 - \beta) + (1 - \beta)^2}; \quad \text{where}$$

$$s > \tilde{s}, \hat{\delta} = \frac{1 + k(1 - s) - \beta}{2 - (1 - k)k(1 - s)}. \quad \tilde{s} = \frac{4 + k - 4k^2 - 4\beta + 3k\beta}{4(1 - k)k} - \frac{\sqrt{(1 - \beta)(8(3 - \beta) - 16k(2 - \beta) + 9k^2(1 - \beta))}}{4(1 - k)k}$$

Taking derivative against  $\hat{\delta}$  with respect to  $s$  or  $\beta$ , then we can get the directional impacts.

$$\text{By substitute } s = 0 < \tilde{s}, \text{ we get } \hat{\delta} = 1 - \frac{4k(1 - 2k) + 2\sqrt{k^2((1 - 2k)^2 + \beta)(4 - (3 - \beta)\beta)}}{4k(1 - k)(3 - \beta) + (1 - \beta)^2}.$$

$$\text{By substitute } s = 1 > \tilde{s}, \text{ we get } \hat{\delta} = \frac{1 - \beta}{2}.$$

We prove Proposition 4 and Corollary 1 ■



**Proof for Proposition 6:**

When the daily-deal website announce a revenue sharing ratio,  $s$ , merchants whose  $\delta < \hat{\delta}$  offer deals on the website. Among the participating merchants who offer deals, for those  $\underline{\delta} < \delta < \hat{\delta}$ , the optimal discount rate is  $d^* = \hat{d}$ , and for those  $0 < \delta < \underline{\delta} \cap 0 < \delta < \hat{\delta}$ , the optimal discount rate is  $d^* = 1 - k$ . Thus, website's revenue from Equation 4 is:  $\pi_W = s \int_0^{\hat{\delta}} (\delta n_C (1 - k / 2) p k + (1 - \delta) n_C / 2 p k) d\delta$ , if  $0 < \delta < \underline{\delta} \cap 0 < \delta < \hat{\delta}$ , or

$$\pi_W = s \int_{\underline{\delta}}^{\hat{\delta}} (\delta n_C (1 - (1 - \hat{d}) / 2) p (1 - \hat{d}) + (1 - \delta) n_C (1 - (1 - \hat{d}) / (k2)) p (1 - \hat{d})) d\delta + s \int_0^{\underline{\delta}} (\delta n_C (1 - k / 2) p k + (1 - \delta) n_C / 2 p k) d\delta. \text{ And the website's}$$

revenue maximization problem is:  $\max_s \pi_W$  ■